NM ZONE

United States Department of Agriculture | Forest Service | Southwestern Region | 517 Gold Avenue SW. Albuquerque, NM 87102-0084

Reply to: 3400 Date: January 26, 1989

Subject: Biological Evaluation, Kachina Peaks Wilderness

To: Forest Supervisor, Coconino National Forest

INTRODUCTION

In early October, Borys Tkacz, Arizona Zone Leader and Jill Wilson, Entomologist, from Forest Pest Management (FPM) were contacted by Allen Farnsworth, Forestry Technician, Elden Ranger District (RD), Coconino National Forest (NF). The Elden and Flagstaff RDs are in the process of preparing a management plan for the Kachina Peaks Wilderness Area. The use of prescribed fire is being considered as a management tool within the wilderness in this plan. Allen requested that FPM conduct a preliminary pest assessment in the wilderness to determine types of pests present in the area and to provide information on how fire exclusion affects those pests. He suggested specific areas that might be of interest to the ID Team. This evaluation describes general insect and disease conditions within the wilderness and discusses known relationships between fire and two pests, the western spruce budworm and dwarf mistletoe.

METHODS

Information regarding present and past pest incidence in the wilderness was collected through roadside surveys, transects as well as aerial survey maps. Roadside surveys were conducted on Forest Road (FR) 522 (which forms the southern boundary of the wilderness) and two sections of 146 (one section forms part of the eastern boundary of the wilderness and the other a watershed road extending from the Inner Basin to Abineau Canyon) (Figure 1). Points were located at 1/4 mile intervals. At each point overstory species composition, size classes, and any pests were noted. In addition, 4 transects originally located for a fuels survey were examined for pest incidence. These transects were all located in the southern part of the wilderness in the vicinity of FR 522. The transects were 50 chains long with points at 5 chain intervals. The same information was recorded for these. Historical information regarding insect and disease incidence was collected from examination of aerial survey maps from 1978-1988 and past reports.

RESULTS AND DISCUSSION

Roadside Surveys

The three roads surveyed covered portions of the south, east, and north sections of the wilderness. Results of the survey are shown in Table 1. The southern portion, traversed by FR 522 contained near pure ponderosa forests with patches

of aspen at lower elevations and mixed conifer forest at the end at higher elevations. Dwarf mistletoe was prevalent in the pine particularly in uneven aged stands. There were also areas of predominately even-aged pole stands that were dense, but pest free. These areas probably resulted from an old fire, some large old snags were still present. Aspen was noted throughout the area surveyed. Some of the aspen stands were severely infected with three pathogens, Marssonina populi, aspen leaf blight, Phellinus tremulae, aspen truck rot, and Encoelia pruinosa, sooty bark canker. Little or no aspen regeneration was observed, perhaps as a result of past fire exclusion. Douglas-fir and limber pine were recorded at about one third of the stops. Dwarf mistletoe was found on 20 percent of the points with Douglas-fir. Douglas-fir was not a common component of areas surveyed except at the higher elevations and in drainages. Limber pine occurred as scattered individuals and was virtually pest free.

The area surveyed along road 146 between Schultz pass and the Inner Basin displayed tremendous vegetative diversity, dependent primarily upon aspect and elevation. Nearly all stands were uneven-aged. Douglas-fir was the most commonly recorded species and was heavily infected with mistletoe in many areas, including some areas of mortality. White fir was also fairly common particularly on north facing aspects and canyons. Scattered individuals were present on east slopes. Some pockets of western spruce budworm defoliation were found in those areas, primarily in dense stands within canyons and on north aspects. Limber pine was common throughout the area particularly on the south and east facing slopes. Southwest dwarf mistletoe was not as abundant in the area as along FR 522. Aspen was recorded at 39 percent of the stops, the stands were primarily pole size and larger, with little regeneration. At higher elevations Engelmann spruce and Corkbark fir became more abundant. Defoliation from western spruce budworm was noted here on the fir.

The last road surveyed, a section of FR 146, extended from the inner basin to Abineau Canyon. Primarily higher altitude species were found, with corkbark fir most often recorded. Most of the stands were uneven-aged. Western spruce budworm defoliation was noted in several areas on the fir and mortality from Fomes annosus (Annosus root disease) and Dryocoetes confusus (Western balsam bark beetle) was also common. Engelmann spruce predominated at higher elevations, with some limited mortality caused by spruce beetle and Armillaria (Armillaria root disease). In Douglas-fir, dwarf mistletoe was common.

Transects

The four transects were located on the south side of the wilderness, above FR 522. Results are shown in Table 2. Transects 4 and 5 originated from Friedlein Prairie Tank. Ponderosa pine was the predominant species on both transects, however, the area to the northwest of the tank (transect 5) was composed of uneven-aged stands. Some aspen, limber pine, and Douglas-fir were present. Southwest dwarf mistletoe infection was patchy and in some cases severe in the area. The area north and east of the tank, transect 4, was composed of an even-aged pole-sawtimber sized stand of ponderosa pine. No dwarf mistletoe was observed. Transects 9 and 11 were both located at higher elevation. Uneven-aged stands of ponderosa pine, limber pine, Douglas-fir, and mature aspen clones were present. Douglas-fir dwarf mistletoe was one of the most common pests recorded. Many of the aspen stands were overmature and disease incidence was high. Aspen trunk rot and a number of stem cankers were common. Virtually no regeneration was observed in the aspen.

Historical Records

Historical records from aerial detection surveys indicate that true fir mortality has been common in the past 10 years. This mortality has been caused by a complex of pests including root diseases and bark beetles. In some years extensive mortality has occurred throughout the mixed conifer type. Light defoliation of true fir, Douglas-fir, and spruce by unknown agents was also recorded as well as light and moderate defoliation of aspen. Aerial surveys do not provide information on dwarf mistletoe incidence and severity.

In 1980, R.L. Mathiasen and F.G. Hawksworth completed a report on taxonomy and effects of dwarf mistletoe on bristlecone pine on the San Francisco Peaks. They report that about 12 percent of the area occupied by bristlecone pine on the peaks is infested with dwarf mistletoe, however, the noninfested stands are generally isolated from the infested stands. In addition, this species of dwarf mistletoe, Arceuthobium microcarpum, has an upper elevational limit well below that of bristlecone pine on the peaks. They concluded that mistletoe was not a serious threat to the bristlecone pine in the area.

INTERACTIONS BETWEEN FIRE AND PESTS

The reason FPM was asked to provide input to the wilderness management plan was to indicate how fire exclusion may have affected past and present insect and disease conditions within the wilderness. We further considered the question of whether or not the absence of natural fires could alter the population dynamics and impacts of forest insects and diseases in the area. Within wilderness areas indigenous insects and plant diseases are to be allowed to play as nearly as possible their natural ecological roles (FSM 2324.11), as are lightning caused fires (FSM 2324.21). For some of the insects and diseases recorded in this report, relationships between fire and population dynamics are unknown, however, there has been growing evidence that fire exclusion has led to intensification of certain pest problems. Most interactions between pests and fire are indirect through changes in stand or host condition. Western spruce budworm and dwarf mistletoe can both have a greater impact under fire exclusion and will be discussed. Interactions between aspen pests and fire are not well documented but some general issues related to aspen biology and fire will be mentioned.

Fire and Western Spruce Budworm

The western spruce budworm is the principal insect defoliator within the mixed conifer type in Arizona and New Mexico. Budworm defoliates the new growth of its hosts. In this Region it primarily feeds on white fir and Douglas-fir, but spruce and corkbark fir are also defoliated. Damage is caused by the larval stages of the insect which mine needles and buds as well chew on foliage. Budworm defoliation causes radial growth loss, top-kill and sometimes tree mortality of its hosts. The severity of impact varies with site quality and defoliation intensity. Generally trees on harsher sites experience greater radial growth losses. Top-kill and mortality occur in stands experiencing repeated defoliation.

Stand susceptibility is affected by many factors including species composition, stand density, height class structure, vigor, maturity, site climate, regional climate, and surrounding host type. In general, the more susceptible stands are composed of dense, uneven-aged, low vigor stands composed of higher proportions of shade tolerant host species. In the southwest, site climates characterized

by mesic white fir habitat types are most favorable to budworm development. In general outbreak frequency is higher in warm, dry regional climates.

Many of these conditions can develop when fire is excluded from the forest ecosystem. This has led many entomologists to believe that the practice of fire exclusion has intensified budworm outbreaks in the last century and some work has indicated this in the northwest. In the southwest, fire frequency in the mixed conifer type has not been widely studied, however, available information indicates a fire frequency of 22 years prior to 1900. Further, tree ring analysis in northern New Mexico has indicated that growth losses for the most recent budworm outbreak were more severe than for any previous outbreaks over a 283 year period. This may be an indication of effects of fire exclusion. Fire can hold forest succession at a particular stage or even reverse it, which can reduce stand susceptibility to budworm. Many budworm susceptible habitat types have ponderosa pine as a major seral species and in these areas fire can maintain seral stand conditions.

The important question, however, in wilderness management is what would be the natural condition of the forest and the natural range of budworm population densities. Most evidence currently indicates that fire was much more prevalent in the past and that stands were probably more seral in nature than now. There are also indications that budworm impacts were less severe in the past than at present. The available evidence points to the inclusion of prescribed fire in natural southwest ecosystems. The increased severity of western spruce budworm damage in many areas in the west may be a symptom of the disturbance of natural processes because of the absence of fire.

Fire and Dwarf Mistletoe

Dwarf mistletoes are parasitic seed bearing plants, dependent upon their hosts for water and nutrients. Mistletoe plants are composed of an aerial shoot system which functions mainly for reproduction and an endophytic system, a specialized root-like structure that grows into the xylem and phloem of the host. Dwarf mistletoes are spread by explosively released seeds. Most infections take place through the bark on needle bearing portions of twigs. It may take several years for shoots to appear, this is called the latent period. Spread of infections in ponderosa pine stands in the southwest is a function of stand age, density, and site index, and averages 1-2 feet per year. Spread is most efficient from an infected overstory to an understory, and slowest through even-aged stands.

Fire is believed to be the primary natural ecological factor governing distribution and abundance of dwarf mistletoe. However, fire can both increase and decrease mistletoe severity. Relatively complete burns have a sanitizing effect on infected stands. Partial burns that leave scattered infected trees or groups of trees throughout a stand can lead to rapid spread of mistletoe to the regenerating stand. Frequent low intensity fires reduce infections in the lower crown through branch pruning. Fire exclusion tends to intensify southwest dwarf mistletoe infection in lower crowns and aids in the development of dense understories that can be rapidly infected from an infected overstory. It also leads to increased fuel levels through development of witches brooms, resin filled stem cankers, duff build-up, and spike tops.

The available information indicates that fires burned more frequently in the past. It is likely that vegetation diversity was greater as well. Probably mistletoe is more severe now, especially in areas that have experienced both

selective logging and fire exclusion. Introducing prescribed fire to the wilderness would restore forests to more natural condition and probably reduce levels of dwarf mistletoe infection.

Fire and Aspen

Without fire, aspen stands are often replaced by grass, forbs, shrubs, or conifers. Almost all even-aged aspen stands in the west appear to be the result of severe fires. In the absence of fire there has been reduction in rate of regeneration in the west. Most aspen stands are pole and sawtimber-sized now. Aspen stands generally do not burn readily, however the species is extremely sensitive to fire, even light fires can kill and repeated prescribed fires can eliminate aspen. Infrequent moderate intensity fires can retain viable stands since suckering will occur following overstory mortality. Aspen is generally a short-lived species and trunk decays and cankers are common on decadent trees. Presence of these diseases can reduce suckering potential. To maintain viable stands of aspen within the wilderness, it is clear that some form of disturbance, such as fire, will be necessary.

CONCLUSIONS

Our preliminary investigation indicates that several pests are presently impacting resources within the Kachina Peaks Wilderness. Effects of several of these pests, notably the western spruce budworm, and dwarf mistletoe may be causing more severe impacts because of past fire exclusion practices. Population levels of these pests are probably higher than would be found in a natural ecosystem where fire was allowed to play it's natural role. However, the relative importance of insect and disease impacts on wilderness resources is determined by management goals. Once these have been established, and fire management units have been delineated, we can upon request conduct more intensive, site specific insect and disease surveys that would evaluate the effects of different fire management prescriptions on insects and diseases.

If you have any questions regarding insects or diseases in your area please call Borys or Jill at FTS 765-7357 or -7358.

Douglas L. Parker

DOUGLAS L. PARKER
Director of Forest Pest Management

Enclosures (4)

cc:
AZ Zone
NM Zone
Elden RD, Art Matthias, Ron Melcher, Allen Farnsworth
Flagstaff RD, Max Reid, Tom Holden

TABLE 1

Kachina Peaks Wilderness Survey
Roadside Surveys

Road*	Tree**	% Occurrence	Pests (Percent Occurrence)
522	PIPO	100.0	Dwarf mistletoe (35.7), W. gall rust (7.1)
	POTR	64.3	Aspen trunk rot (33.3), Aspen leaf blight (22.2) Sooty-bark canker (22.2)
	PSME	35.7	Dwarf mistletoe (20)
	PIFL	35.7	
146E	PSME	89.3	Dwarf mistletoe (76)
	ABCO	75.0	Frost (19.0), W. spruce budworm (9.5), Armillaria root disease/Fir engraver beetle (4.8)
	PIFL	71.4	
	PIPO	51.6	Dwarf mistletoe (13.3), Commandra rust (6.7)
	POTR	39.3	Aspen truck rot (9.1), Sooty bark canker (9.1)
	ABLA	10.7	Armillaria root disease/W. balsam bark beetle (66.6), W. spruce budworm (33.3)
	PIEN	7.1	
	PIAR	3.6	
146N	POTR	100.0	
	ABLA	70.6	W. spruce budworm (41.7), Annosus root disease/ W. balsam bark beetle (25.0)
	PSME	64.7	Dwarf mistletoe (63.6)
	PIEN	52.9	Spruce beetle (11.1), Red ring rot (11.1) Armillaria root disease (11.1)
	PIFL	47.1	
	PIAR	23.5	

*146E refers to the section of road 146 between Schultz pass and the inner basin.

146N refers to the section of road 146 between the Inner Basin and Abineau Canyon.

**ABCO - Abies concolor, ABLA - Abies lasiocarpa, PIAR - Pinus aristata, PIEN - Picea engelmannii, PIFL - Pinus flexilis, PIPO - Pinus ponderosa, POTR - Populus tremuloides, PSME - Pseudotsuga menziesii

TABLE 2

Kachina Peaks Wilderness Survey
Transects

Transect	Tree*	Incidence**	Pests (Percent Occurrence)
5	PIPO	10	Armillaria root disease/Flatheads (10) Red turpentine beetle (10), Dwarf mistletoe (80) Lightning (10), Porcupine (10), Unknown (10)
	PSME	4	
	PIFL	3	
	POTR	3	Aspen leaf blight (33)
4	PIPO	10	W. gall rust (10)
	PIFL	1	
9	PIPO	9	Lightning (11), Limb rust (11)
	PSME	9	Dwarf mistletoe (56)
	PIFL	7	Needle cast (14)
	POTR	5	Aspen trunk rot (60), Black canker (20) Sooty bark canker (40), Aspen leaf blight (20)
	ABCO	1	
11	PIPO	8	
	PIFL	8	
	POTR	8	Aspen truck rot (100), Sooty bark canker (38), Black canker (25), Hypoxylon canker (25)
	PSME	7	Dwarf mistletoe (29)
	PIEN	1	Gall aphid (100)
	ABCO	1	
	PIAR	1	

*ABCO - Abies concolor, PIAR - Pinus aristata, PIEN - Picea engelmannii, PIFL - Pinus flexilis, PIPO - Pinus ponderosa, POTR - Populus tremuloides, PSME - Pseudotsuga menziesii

**Incidence reflects number of points per transect that the species was found. There were 10 points per transect.

FIGURE 1

Kachina Peaks Wilderness
Survey

Roadside Survey

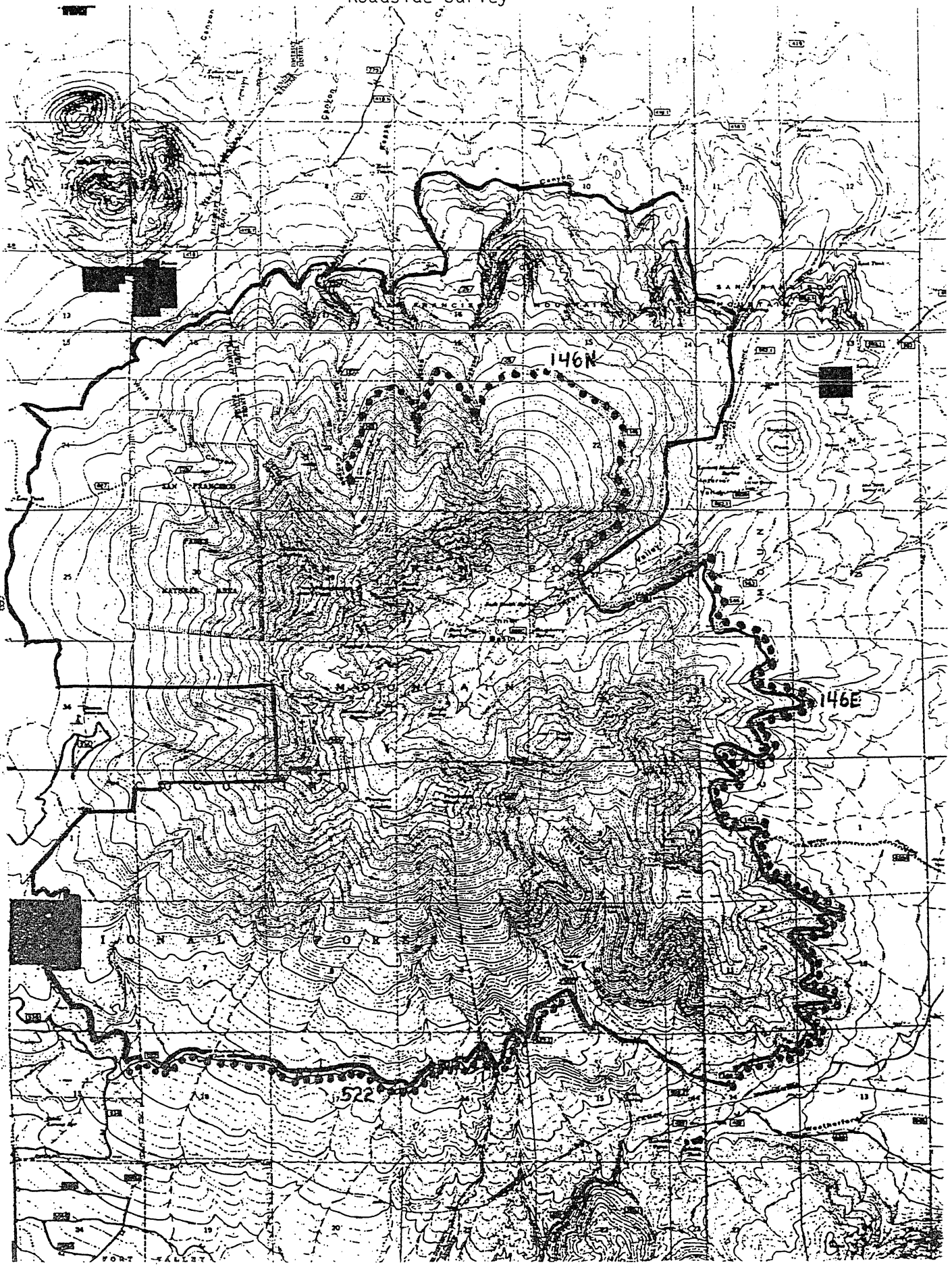

FIGURE 2

Kachina Peaks Wilderness
Survey

Transects